Excellent Analysis
Top Notch!
J.

IMPACT OF

WORK CENTERS ON

WILDFIRE RESPONSE TIMES

By Jeffrey L. Baumann
Dispatch and Technology Coordinator
South Carolina Forestry Commission
January 22, 2003

Impact of Work Centers on Wildfire Response Times

By Jeffrey L. Baumann

The distribution of resources to fight wildfires has changed over the years in South Carolina due to budget cuts, downsizing of state government and available workforce. Resources responding from their residence may not be providing the best possible response times to wildfires and increasing the acreage burned. Resources responding from a strategically located work center may improve response times and reduce acreage burned by wildfires.

Agency Mission and History

The South Carolina Forestry Commission was established in 1927 with a duty to "*...take such action and afford such organized means as may be necessary to prevent, control and extinguish fires....*" In 1931, it was estimated that 11,783 fires had burned 2,403,000 acres that year. Fires burning over large areas caused heavy smoke that drove tourists from the roads, interfered with airmail, and even prohibited ships from entering Charleston Harbor.

With the creation of the Civilian Conservation Corps (CCC) in the early 1930's, President Roosevelt authorized the allocated of 17 CCC forestry camps in 13 coastal counties of South Carolina. The forestry force in South Carolina jumped from less than a dozen men with practically no equipment, to some 3,200 CCC boys, 125 supervisory foreman, 144 trucks, 30 tractors, and $25,000 worth of small tools.

In 1943 the General Assembly recognized the responsibility of the State in protecting all forestlands and initiated the first step towards a statewide forest fire control organization. The passage of the Statewide Forest Fire Protection Act in 1945 allowed for the rapid expansion of fire suppression and prevention activities by the Forestry Commission. Competent personnel, materials, and equipment were scarce because of the war. But the Commission was able to purchase 7 medium size John Deere farm tractors with disc tiller-type plows. These were

transported on four-wheel trailers pulled by 1½ ton trucks. This was the start of the mechanized forest fire suppression organization in use today.

From 1945 through 1966, part-time Tractor Operators operated the mechanized equipment used in forest fire suppression. The state legislature appropriated funds in 1966 to employ these part-time personnel full time. On July 1, 1970, all Tractor Operators were transferred to the position of Fire Warden with their residences as their standby station. Appendix A shows the distribution of Fire Wardens standby stations around the state in Fiscal Year 2002. This was recognized as a major contribution to the overall efficiency of the County Fire Control Organization. From 1970 forward, the average acres burned per fire has been less than 10 acres.

Table 1. Historical Records for Greatest Acreage Losses in South Carolina and for Most Recent Years

Fiscal Year	Number of Fires	Acres Burned	Average Acres/Fire	Mechanized Equipment	
				Tracked	Wheel
1947	6,601	232,040	35.2	5	36
1950	8,424	240,504	28.5	11	24
1951	6,643	147,840	22.2	11	24
1954	6,532	119,142	18.2	16	29
1955	7,022	158,786	22.6	31	21
1966	5,467	127,804	23.4	105	0
1981	14,405	94,909	6.6	215	0
1985	14,260	114,167	8.0	196	0
1999	6,590	35,062	5.3	170	0
2002	6,383	49,390	7.7	168	0

During fiscal year 1990, the Forestry Commission initiated a new career path for wardens that consisted of a training program to prepare them to assist foresters and rangers in forest technician activities or one of several trade areas such as carpentry, plumbing, or welding. The course requires approximately two years of study, on-the-job training and experience. Current Fire Wardens could enroll in this program and receive a promotion to a Forest Warden I and another promotion to a Forest Warden II when they successfully completed all training

requirements (see Table 2). All newly hired wardens are employed as Forest Wardens I and required to complete the Forest Warden training program.

Table 2. New Warden Job Classes Created in Fiscal Year 1990 and Salary Schedule as of December 2, 1989

Forestry Job Class	Minimum Salary	Maximum Salary
Fire Warden	$12,518	$18,777
Forest Warden I	$14,644	$21,966
Forest Warden II	$16,472	$24,708

This program not only implemented a career path for a large portion of the Forestry Commission's workforce, but it provided an opportunity for the agency to utilize these employees in areas other than fire suppression. Using data collected by the Commission's computer aided dispatch system (CADS) for fiscal year 2002, wardens spend an average of 9% of their work time suppressing wildfires (see Table 3). A detail listing by warden position in fiscal year 2002 can be found in Appendix B.

Table 3. Number of Fires, Suppression Hours[1] and Percent of Work Year[2] Spent on Fire Suppression for Fiscal Year 2002 as Captured by the Commission's Computer Aided Dispatch System.

Warden	Number of Fires Responded To	Total Suppression Hours[1]	Percent of Work Year on Fire Suppression[2]
Minimum	**1**	**0.10**	**0.01%**
Median	**44**	**120.07**	**7.62%**
Maximum	**165**	**442.47**	**28.09%**
Average	**52.5**	**141.57**	**8.99%**

[1] Time from first contact to returning to the standby station
[2] Based on 210 day work year and 7 ½ hour work days

A Look At Work Centers

Budget cuts and "downsizing" of state government are forcing agencies to look for more efficient and effective ways to accomplish their mission. The implementation of new regulations like commercial driver licenses, drug testing, physical fitness standards, etc. is making it harder to maintain a distributed workforce (see Appendix A). Under current labor regulations, on any

given day, one-third of this distributed workforce could be off duty. One concept that has been mentioned for years is to move from residence standby stations and implement strategically located work centers. In fact, South Carolina is one of only two states in the South (see Table 4) with full time tractor operators that hasn't implemented workstations.

Table 4. Survey of Tractor Operator Work Arrangements for the Thirteen Southern States Conducted in December 2002

STATE	Full Time Tractor Operators	Units Stationed at Workstations during Daytime	Units Stationed at Homes during Nights/Weekends	Distance from Workstation Requirements
Alabama	Yes	Yes	Yes	
Arkansas	Yes	Yes	No[1]	
Florida	Yes	Yes	No[1]	
Georgia	Yes	Yes	No[1]	
Kentucky	Seasonal	Yes	Yes	
Louisiana	Yes	Yes	Yes	
Mississippi	Yes	Yes	Yes	
North Carolina	Yes	Yes	No[1]	
Oklahoma	Yes	No	Yes	Within 15 minutes[2]
South Carolina	Yes	No	Yes	
Tennessee	Yes	Yes	No[1]	
Texas	Yes	Yes	No[1]	Within 12 miles
Virginia	No	No	No	

[1]Except during times of high fire danger
[2]From "hiring point"

Impact on Response Times

The average response time for the initial attack warden is a performance measure in the Forestry Commission's Accountability Report. The response time is calculated from when the wildfire call is received to the arrival of the first warden at the fire. For fiscal year 2002, the average response time was 34.8 minutes. The agency goal is an average response time of 30 minutes or less. Table 5 is a comparison of the average response time for the last four fiscal years. The table also lists the average for various dispatching and responding components captured by the Forestry Commission's computer aided dispatch system that impact the total response time. These can be used for further comparison, analysis and process improvement monitoring.

Table 5. Summary and Comparison of Dispatch Times for Fiscal Years 1999, 2000, 2001, and 2002

TIMES	FY 1999 Average (Minutes)	FY 2000 Average (Minutes)	FY 2001 Average (Minutes)	FY 2002 Average (Minutes)
Dispatching[1]	6.11	5.68	5.42	6.27
Contact Establish[2]	4.39	4.14	4.00	3.09
Rolling[3]	4.38	4.37	3.97	3.69
Enroute[4]	8.32	8.40	7.72	6.06
Travel[5]	24.48	23.60	23.03	22.60
Response[6]	36.92	35.05	34.40	34.80

[1] Time between initial report of wildfire and first attempt to contact initial attack warden.
[2] Time between first attempt to contact warden and when contact was established.
[3]Time between contact established with warden and his enroute time.
[4] Time between first attempt to contact warden and his enroute time.
[5] Time between going enroute and arriving at wildfire.
[6] Time between initial report of wildfire and arrival of initial attack warden.

Average response times are also calculated on a county basis. Appendix C lists the average response time for fires in each county for the last four fiscal years and a 4-year average. For this project, calculating the impact on response times if the initial attack warden responded from a work center was limited to six counties. The six counties would include the two counties with the lowest response times (Abbeville and Saluda), two counties with response times near or at the state average (Bamberg and Marion), and the two counties with the longest response times (Horry and Charleston). The analysis would also be limited to fires that occur during hours the work center would be staffed. Appendix D contains charts plotting when wildfires were reported to the Forestry Commission from fiscal years 1998 through 2002. Based on this analysis, 84% of the wildfires are reported between 10:00 and 20:00 hours. Adjustments in work center staffing for weekday and seasonal trends may be needed to reduce potential overtime.

An analysis was also performed to see if the response time comparison could be limited to fiscal year 2002 fires. The "geographical center" for the fires in the project counties was calculated for fiscal years 1998 through 2002 and for 2002. Appendix E are maps for each of the project counties showing the "geographical center" for the 5 year period and for fiscal year 2002.

Since they were within a few miles of each other for each project counties, it was concluded that a sample of fiscal year 2002 fires would be representative enough for this analysis. A random number generator was used to select 25% of the fires that had occurred between 10:00 and 20:00 hours in the project counties in fiscal year 2002. As a minimum, 10 fires were sampled in each project county and no less than 20% of fire for that county (see Table 6).

Table 6. Number of Fires for FY 2002 With Initial Attack Warden Response Times and Number and Percentage Sampled to Estimate Response Time from Closest Work Center

County	Total Number of Fires with Initial Attack Warden Response Times (FY 2002)	Number of Fires Sampled to Estimate Response Time from Closest Work Center	Percentage of FY 2002 Fires with Initial Attack Warden Response Times Sampled
Abbeville	**24**	**10**	**42%**
Bamberg	**34**	**10**	**29%**
Charleston	**71**	**14**	**20%**
Horry	**267**	**64**	**24%**
Marion	**61**	**12**	**20%**
Saluda	**29**	**10**	**34%**
Project Area Totals	**486**	**120**	**25%**

Potential work center sites were selected across the state. Based on the current average travel time of 22.6 minutes (see Table 5), work centers should be 30-40 miles apart or cover approximately 1,000 square miles (i.e. 18-mile radius circle). This would amount to 30-36 work centers across the state. The Forestry Commission owns over 120 sites of 4 acres or more. For this project first priority was given to sites with existing facilities suitable for a work center. Second priority was given to sites with established utilities (i.e. water and septic tanks) to fill large gaps left from the first group of work center sites. Thirty-three sites were selected as potential work centers (see Appendix F). Thiessen Polygons were created around each work center with MapInfo Professional® v7.0 GIS software showing their area of influence. This

Voronoi Diagram would help determine the closest work center to each fire and calculate other comparative data (see Appendix G).

The Routing tool in the GIS/desktop mapping application Maptitude® was used to calculate the shortest route from the closest work center to each fire that was selected at random for each project county. The estimated response time was calculated based on that mileage, an average travel speed of 30 miles per hour, 6 minutes dispatch time, and 4 minutes for the warden to get enroute. This estimated response time was compared with the actual response time and their difference calculated (see Appendix H). Based on this sample analysis of 120 fires, work center locations, and conservative estimated response times, responding from work centers would save on average 1.4 minutes per fire (See Table 7). Unfortunately, on the county level this "savings" is not as obvious.

Table 7. Comparison of Actual Response Time for Initial Attack Warden and Estimated Response Time[1] for Initial Attack Warden Responding from Closest Work Center

County	Actual Response Time for Initial Attack Warden (Minutes)	Average Road Mileage to Fire from Closest Work Center (Miles)	Average Estimated[1] Response Time from Closest Work Center (Minutes)	Difference in Response Time (Work Center minus Actual) (Minutes)
Bamberg	36.98	20.87	51.75	14.77
Abbeville	15.85	23.18	56.35	40.51
Charleston	55.32	12.84	35.68	-19.64
Saluda	16.20	10.30	30.59	14.39
Marion	39.90	13.59	37.17	-2.73
Horry	44.72	12.96	35.93	-8.79
Project Area	**40.01**	**14.30**	**38.61**	**-1.40**

[1]Based on average travel speed of 30 miles per hour and 10 minutes for dispatch and unit to get enroute.

Conclusion

An effort was not made to find the "ideal" number and locations for work centers in this analysis. Work centers were selected based on their current suitability and general location. In addition to the more than 120 possible sites currently owned by the Forestry Commission, there are countless other available sites that "cooperators" could make available to the Commission at no or low cost. To see an overall reduction in response times using the 33 sites that were selected tends to verify that the work center concept would either have no impact or a positive impact on response times especially for those counties that currently have long response times.

In looking at the Abbeville and Bamberg increased response times with work centers, the work center coverage area for those counties is 1,557 and 1,252 square miles respectively. Establishing another work center in these areas to reduce the coverage area to 1,000 square miles or less should improve their situation. Looking at where fires have normally occurred should also be taken into consideration with selecting work center sites. Another opportunity that comes with work centers is the ability to team up and pre-position personnel during high fire activity.

Of the 33 sites selected, only 8 would require some immediate expenditure to make into a work center. Since these 8 sites have a well and septic tank, a "free", federal surplus trailer could be obtained and set up on these locations. An additional $5,000-20,000 may be needed to make necessary repairs, improvements and to build equipment sheds. There may be several opportunities to obtain "surplus" state property for work centers or develop partnerships with other agencies like the Department of Transportation, State Parks or Department of Natural Resources.

To convert the remaining Fire Wardens to Forest Wardens would cost the agency about $350,000 annually in salary increases. With an annual turnover of approximately 12 Fire Warden positions and the agency moving towards hiring only Forest Wardens in the future, this additional cost scenario is likely to be the case either way. Work centers shouldn't add any significant overtime costs if supervisors manage the situations properly. Overtime is normally credited as comp time and compensated for at a later time. If strategically located, work centers may require fewer personnel and help offset any additional salary or equipment needs.

Table 8. Current Number of Fire and Forest Wardens and Salary Schedule as of FY 2003

Forestry Job Class	Number of Positions	Minimum Salary	Average Salary
Fire Warden	84	$14,644	$16,817
Forest Warden	68	$17,819	$21,040
Total Warden FTEs	167		

As of July 1, 1970, all Tractor Operators were classified as full time employees of the State. With the creation of the Forest Warden program in 1989, the Commission began the first steps to expand the duties of the Fire Warden beyond fire suppression. The Forestry Commission should follow the lead of the other southern states and begin implementing work centers around the state to more fully utilize the time and talents of a large segment of its employees. Through proper analysis of historical fire data, population trends, road access, and fire potential, ideal sites for work centers can be identified that will reduce or have little impact on current response times to wildfires.

REFERENCES

Act of General Assembly, Title 48-Chapter 23-Section 90; General duties of Commission

Knight, Miles. Workstation Survey of Southern State, December 2002.

Maptitude Version 4.5 User's Guide, Caliper Corporation, 2001

Report of the State Commission of Forestry for the Year July 1, 1976 to June 30, 1977.

Report of the State Commission of Forestry for the Year July 1, 1984 to June 30, 1985.

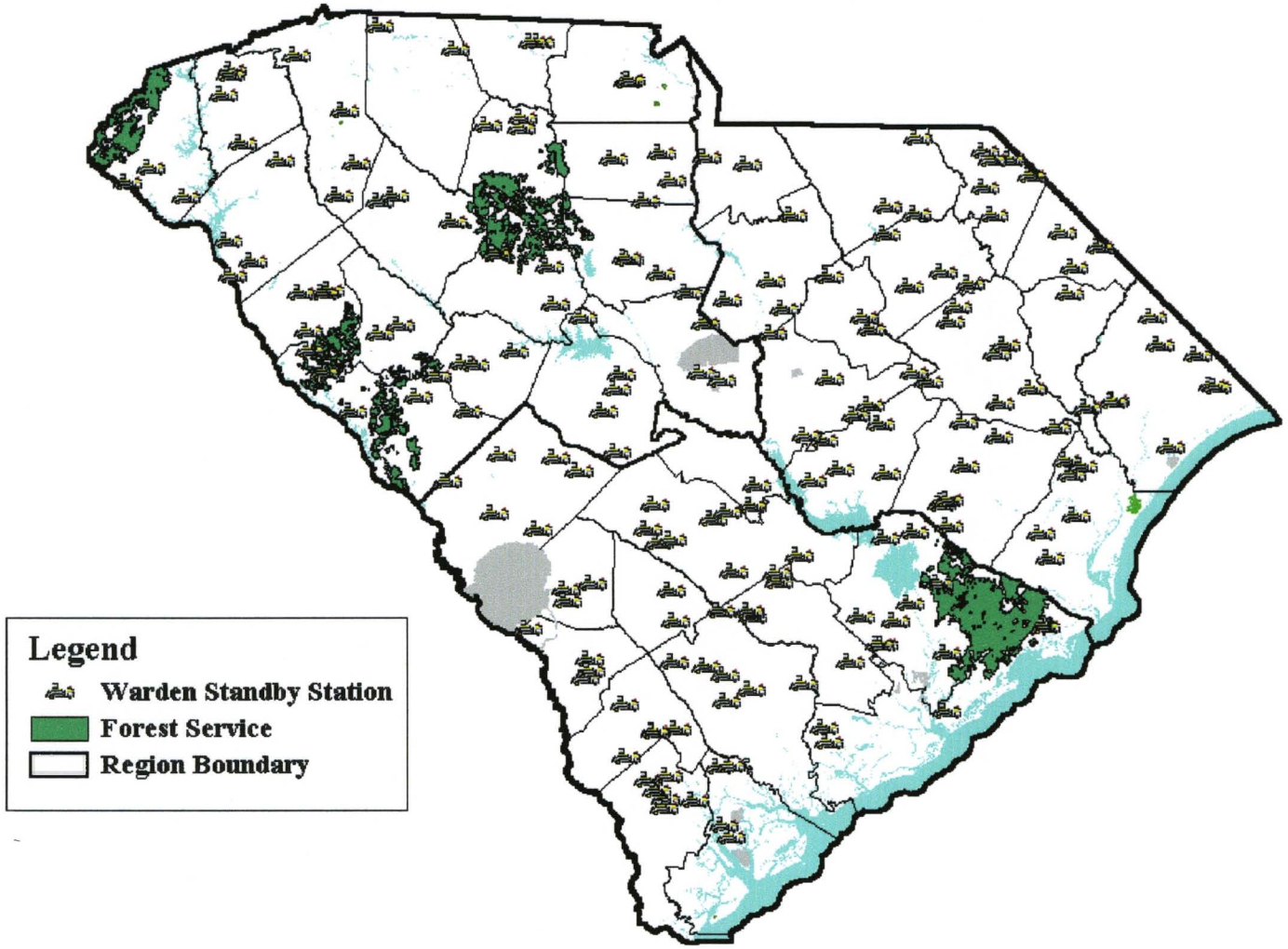
South Carolina Forestry Commission Annual Report -- 1989-1990.

Wentworth, Cy. Analysis of Warden Positions and Workstation Impact, November 2002

APPENDIX

APPENDIX A

Distribution of Warden Standby Stations
Fiscal Year 2002



APPENDIX B

Number of Fires, Suppression Hours and Percent of Fiscal Year 2002 Spent on Fire Suppression by Wardens

Warden	Number of Fires Responded To	Total Suppression Hours[1]	Percent of Work Year on Fire Suppression[2]
B-1-2	46	88.78	5.64%
B-1-3	52	103.29	6.56%
B-1-4	19	38.30	2.43%
B-1-5	66	160.16	10.17%
B-1-6	73	131.52	8.35%
B-2-2	13	24.12	1.53%
B-2-3	19	34.59	2.20%
B-3-2	19	39.12	2.48%
B-3-3	25	45.59	2.89%
B-3-4	30	49.44	3.14%
D-1-2	1	69.37	4.40%
D-1-3	75	194.83	12.37%
D-1-4	58	258.39	16.41%
D-1-5	85	192.72	12.24%
D-2-2	62	258.10	16.39%
D-2-3	80	162.06	10.29%
D-2-4	80	186.85	11.86%
D-3-2	70	168.86	10.72%
D-3-3	63	256.13	16.26%
D-3-4	63	150.05	9.53%
D-4-3	52	137.45	8.73%
D-4-4	59	220.17	13.98%
D-4-5	42	143.51	9.11%
D-4-6	34	78.99	5.02%
G-1-2	9	16.56	1.05%
G-1-3	34	84.89	5.39%
G-1-4	50	128.92	8.19%
G-2-2	30	147.84	9.39%
G-2-3	23	66.40	4.22%
G-3-2	15	46.60	2.96%
G-3-3	37	119.74	7.60%
G-4-2	20	57.93	3.68%
G-4-3	28	62.23	3.95%
G-5-2	32	46.69	2.96%
G-5-3	13	120.39	7.64%
H-1-2	36	70.83	4.50%
H-1-3	39	76.06	4.83%
H-1-5	33	80.57	5.12%
H-2-2	35	65.48	4.16%
H-2-3	68	112.85	7.16%
H-2-4	66	330.84	21.01%

APPENDIX B

Warden	Number of Fires Responded To	Total Suppression Hours[1]	Percent of Work Year on Fire Suppression[2]
H-3-2	70	140.06	8.89%
H-3-3	126	225.82	14.34%
H-3-4	60	131.16	8.33%
H-3-5	55	122.73	7.79%
H-3-6	30	53.65	3.41%
H-3-7	35	70.73	4.49%
H-4-2	1	0.10	0.01%
H-4-3	62	143.94	9.14%
H-4-4	59	133.07	8.45%
H-4-5	43	226.36	14.37%
H-4-6	71	151.14	9.60%
H-4-7	48	125.30	7.96%
H-4-8	97	215.91	13.71%
K-1-2	94	167.07	10.61%
K-1-3	83	209.22	13.28%
K-1-4	74	233.24	14.81%
K-1-5	105	203.21	12.90%
K-1-6	4	4.51	0.29%
K-2-3	63	184.20	11.70%
K-2-4	17	58.32	3.70%
K-2-5	68	252.02	16.00%
K-2-6	89	253.83	16.12%
K-2-7	64	206.20	13.09%
K-3-3	127	308.77	19.60%
K-3-4	37	84.83	5.39%
K-3-5	120	361.35	22.94%
K-3-6	79	209.79	13.32%
K-3-7	116	275.57	17.50%
K-3-8	133	372.59	23.66%
K-3-9	165	383.84	24.37%
L-1-2	94	202.83	12.88%
L-1-3	67	134.20	8.52%
L-1-4	81	107.35	6.82%
L-1-5	25	36.65	2.33%
L-1-6	72	128.56	8.16%
L-2-2	49	89.50	5.68%
L-2-3	34	75.25	4.78%
L-2-4	34	63.97	4.06%
L-2-5	34	157.45	10.00%
M-1-3	130	348.56	22.13%
M-1-4	118	305.18	19.38%
M-1-5	72	197.75	12.56%
M-1-6	87	205.82	13.07%
M-1-7	129	359.34	22.82%
M-1-8	82	149.56	9.50%

APPENDIX B

Warden	Number of Fires Responded To	Total Suppression Hours[1]	Percent of Work Year on Fire Suppression[2]
M-2-3	99	383.77	24.37%
M-2-4	80	322.48	20.47%
M-2-5	93	307.56	19.53%
M-2-6	125	395.91	25.14%
M-2-7	83	340.57	21.62%
M-2-8	85	386.24	24.52%
M-3-2	71	171.02	10.86%
M-3-3	25	83.84	5.32%
M-3-4	22	102.65	6.52%
MC-1-3	110	381.53	24.22%
MC-1-4	114	295.04	18.73%
MC-1-5	150	442.47	28.09%
MC-1-6	93	169.88	10.79%
MC-1-7	129	289.33	18.37%
MC-1-8	11	23.42	1.49%
MC-2-4	37	114.77	7.29%
MC-2-5	51	132.63	8.42%
MC-2-6	52	137.14	8.71%
MC-2-7	9	100.28	6.37%
MC-3-3	37	87.47	5.55%
MC-3-4	44	97.72	6.20%
MC-3-5	40	89.98	5.71%
MC-3-6	43	198.14	12.58%
MC-3-7	114	247.78	15.73%
N-1-2	22	44.35	2.82%
N-1-3	18	37.20	2.36%
N-2-2	18	36.33	2.31%
N-2-3	26	46.60	2.96%
N-2-4	32	59.57	3.78%
N-3-2	39	78.67	4.99%
N-3-3	25	56.65	3.60%
N-4-2	14	19.17	1.22%
N-4-3	13	116.54	7.40%
N-4-4	5	7.88	0.50%
O-1-3	36	70.11	4.45%
O-1-4	7	10.59	0.67%
O-2-2	10	89.71	5.70%
O-2-3	44	86.30	5.48%
O-3-3	48	82.80	5.26%
O-3-4	63	105.79	6.72%
O-3-5	87	168.66	10.71%
O-3-6	79	156.74	9.95%
O-3-7	70	211.50	13.43%
O-3-8	52	293.79	18.65%

APPENDIX B

Warden	Number of Fires Responded To	Total Suppression Hours[1]	Percent of Work Year on Fire Suppression[2]
P-1-2	14	31.48	2.00%
P-1-3	29	95.70	6.08%
P-1-4	13	39.86	2.53%
P-2-2	3	28.03	1.78%
P-2-3	16	53.94	3.42%
P-2-4	18	132.06	8.38%
P-2-5	26	77.49	4.92%
P-3-2	27	91.35	5.80%
P-3-3	23	60.23	3.82%
P-3-4	3	3.08	0.20%
P-4-2	32	74.16	4.71%
P-4-3	30	93.82	5.96%
P-4-4	22	35.79	2.27%
S-1-2	69	199.49	12.67%
S-1-3	37	61.13	3.88%
S-1-4	16	26.45	1.68%
S-1-5	59	101.05	6.42%
S-1-6	40	76.80	4.88%
S-2-2	35	173.50	11.02%
S-2-3	37	80.81	5.13%
S-2-4	11	17.98	1.14%
S-3-2	69	302.79	19.22%
S-3-3	75	169.00	10.73%
S-3-4	46	101.27	6.43%
S-4-2	69	144.01	9.14%
S-4-3	72	178.12	11.31%
S-4-4	61	177.21	11.25%
S-4-5	53	250.51	15.91%
S-4-6	98	195.33	12.40%
S-5-2	38	88.49	5.62%
S-5-3	32	98.62	6.26%
S-6-2	14	29.87	1.90%
S-6-4	13	29.91	1.90%
S-6-5	25	158.31	10.05%
S-7-2	31	56.29	3.57%
S-7-3	34	99.96	6.35%
S-8-3	35	159.25	10.11%
S-8-4	5	12.92	0.82%
Total	**8,812**	**23,784.31**	
Minimum	**1**	**0.10**	**0.01%**
Median	**44**	**120.07**	**7.62%**
Maximum	**165**	**442.47**	**28.09%**
Average	**52.5**	**141.57**	**8.99%**

[1] Time from First Contact to returning to Standby

[2] Based on work year of 210 -- 7 ½ hour days

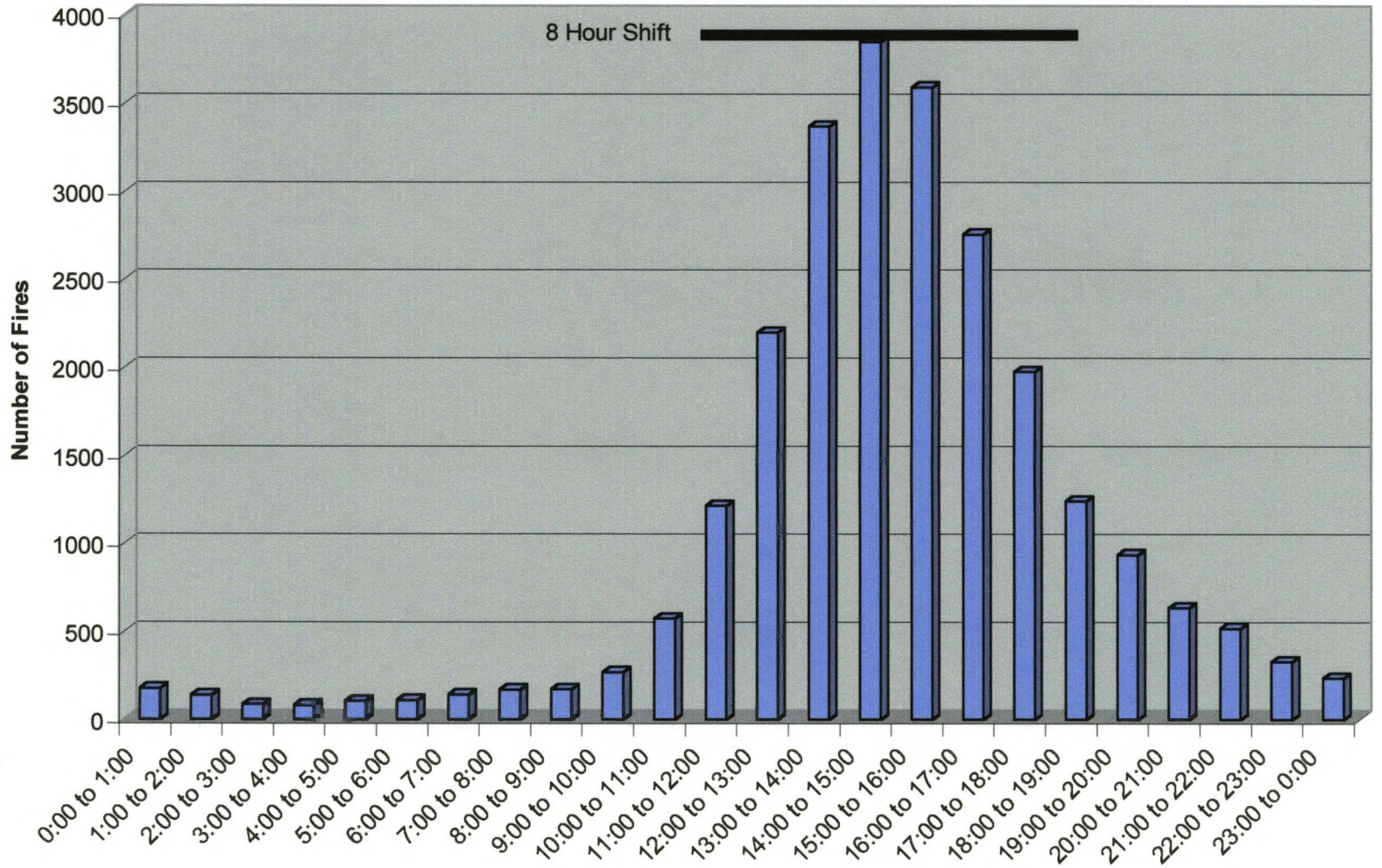
APPENDIX C

Average Response Time for Initial Attack Warden

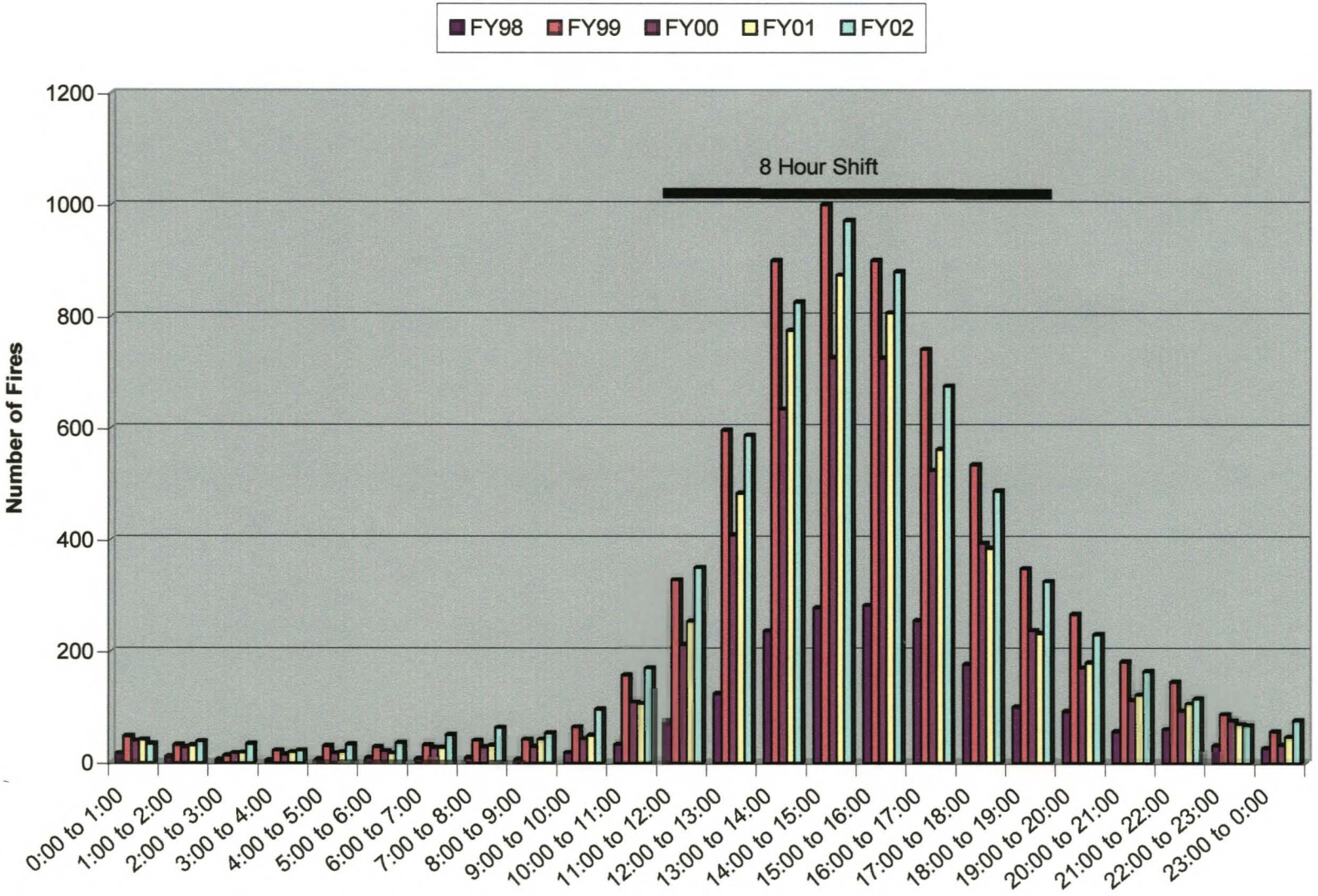
COUNTY	Average Response Time				FY99-02 Average
	FY99	FY00	FY01	FY02	
Abbeville County	23.31	18.74	15.12	19.28	19.11
Aiken County	32.08	36.36	34.61	34.94	34.50
Allendale County	33.80	32.64	37.53	32.49	34.12
Anderson County	38.15	36.57	35.92	33.26	35.98
Bamberg County	37.64	34.92	32.01	37.40	35.49
Barnwell County	33.57	37.67	39.80	35.38	36.61
Beaufort County	39.59	40.83	35.62	36.15	38.05
Berkeley County	44.37	41.89	42.80	44.15	43.30
Calhoun County	27.98	26.84	25.41	42.53	30.69
Charleston County	53.62	55.81	51.83	57.51	54.69
Cherokee County	29.65	30.29	27.04	27.35	28.58
Chester County	43.77	26.22	36.70	25.67	33.09
Chesterfield County	34.06	29.10	32.96	31.93	32.01
Clarendon County	35.18	33.43	31.23	33.22	33.27
Colleton County	38.18	37.03	37.57	33.02	36.45
Darlington County	37.04	35.43	38.28	34.62	36.34
Dillon County	33.71	41.21	37.39	34.25	36.64
Dorchester County	41.30	35.64	36.56	37.16	37.67
Edgefield County	34.89	32.95	30.78	28.78	31.85
Fairfield County	39.51	36.17	28.75	31.20	33.91
Florence County	36.85	36.80	35.51	36.02	36.30
Georgetown County	47.37	38.47	39.25	49.12	43.55
Greenville County	36.92	34.48	37.99	37.82	36.80
Greenwood County	32.83	37.74	41.84	37.37	37.45
Hampton County	28.56	24.85	28.66	25.69	26.94
Horry County	43.76	47.02	44.23	44.55	44.89
Jasper County	34.65	30.45	32.71	28.84	31.66
Kershaw County	32.44	31.01	29.19	30.71	30.84
Lancaster County	39.08	42.58	32.80	40.65	38.78
Laurens County	37.05	36.69	25.93	27.52	31.80
Lee County	31.92	27.62	27.74	25.42	28.18
Lexington County	26.50	26.03	22.03	23.06	24.41
Marion County	35.20	37.37	34.33	36.67	35.89
Marlboro County	28.50	29.24	31.79	39.10	32.16
McCormick County	36.58	43.26	34.63	33.35	36.96
Newberry County	29.30	24.40	20.30	20.50	23.63
Oconee County	30.61	33.60	34.50	36.88	33.90
Orangeburg County	36.20	33.14	35.30	30.87	33.88
Pickens County	26.56	26.70	25.30	20.53	24.77
Richland County	37.98	36.17	35.35	35.81	36.33
Saluda County	19.77	22.82	20.73	18.05	20.34
Spartanburg County	39.81	37.39	39.35	36.55	38.28
Sumter County	30.38	30.90	32.96	27.76	30.50
Union County	26.77	32.00	22.10	25.43	26.58
Williamsburg County	42.29	38.93	36.63	38.04	38.97
York County	30.91	27.16	30.50	29.91	29.62
State Average	36.92	35.05	34.40	34.80	35.29

APPENDIX D

Distribution of Fires by Hour
Fiscal Years 1998 to 2002

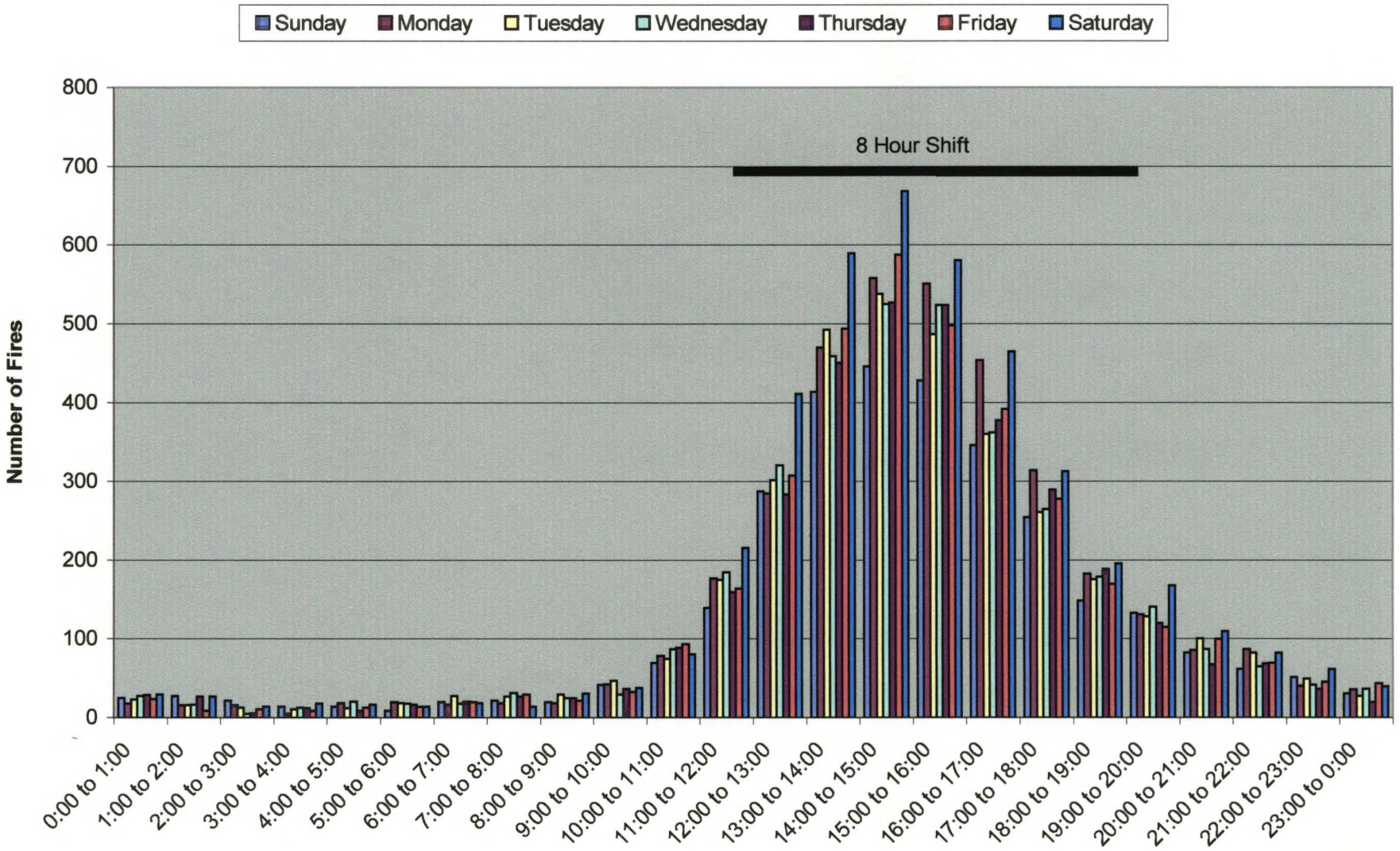


Distribution of Fires by Hour and Fiscal Year

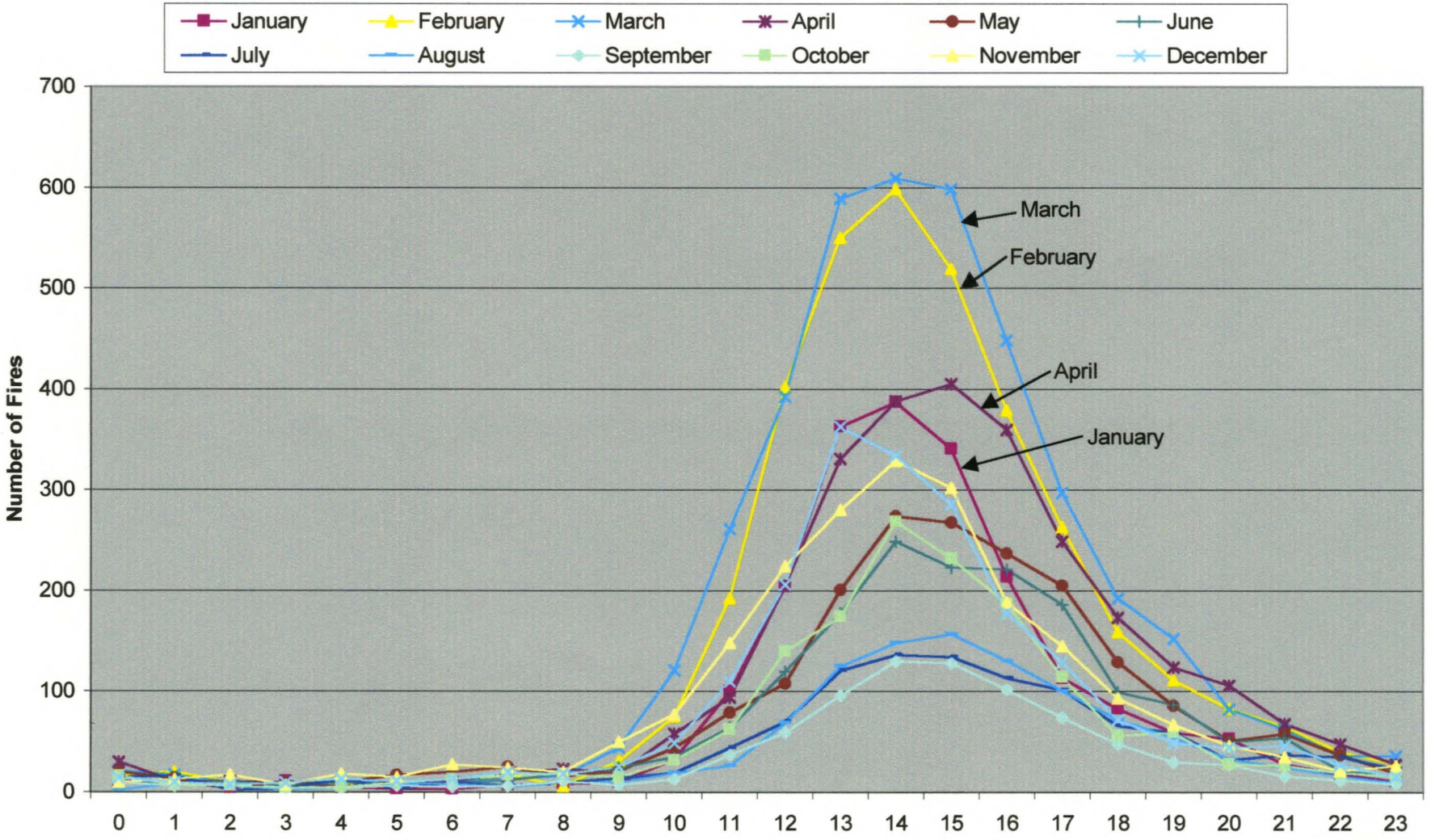


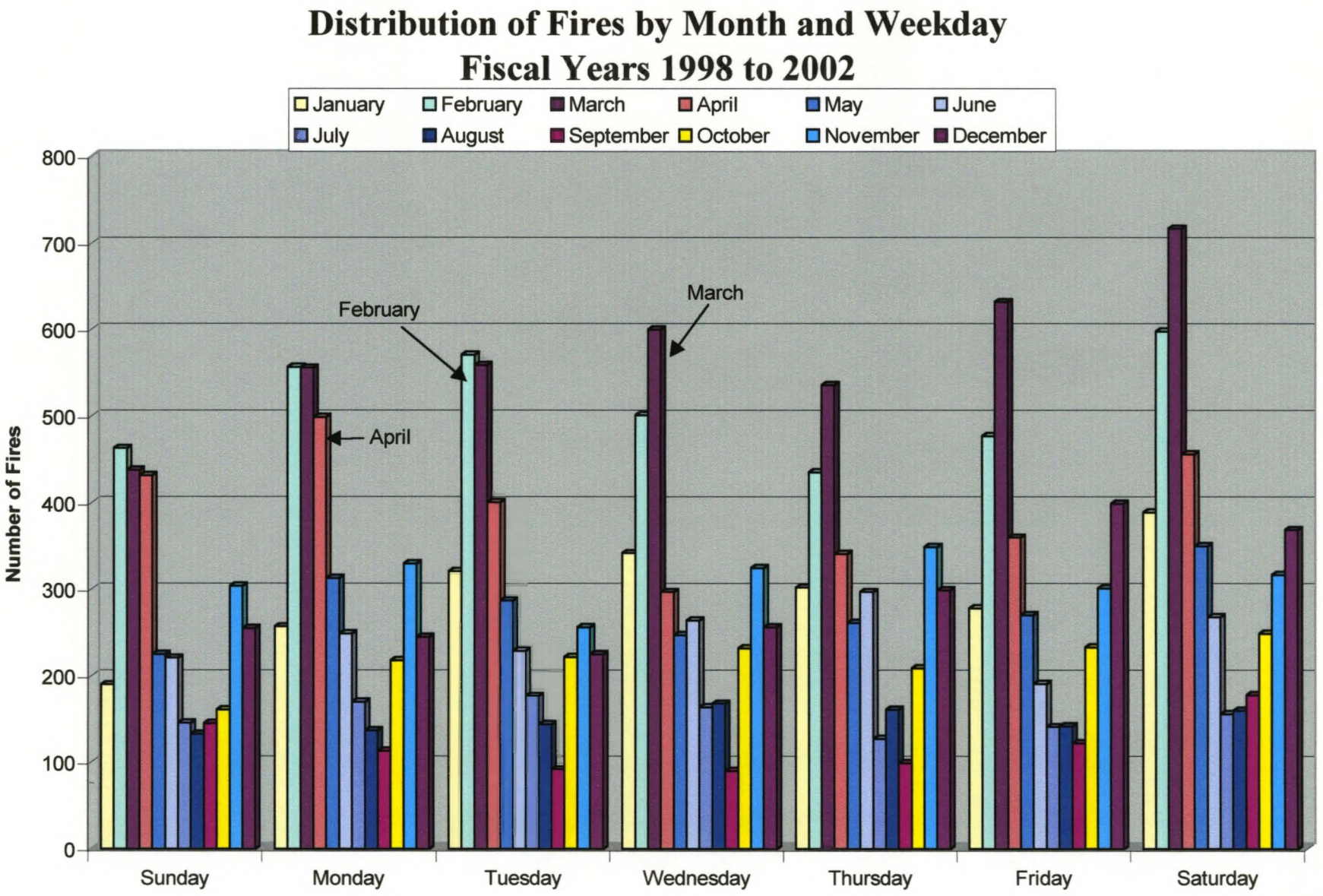
APPENDIX D

Distribution of Fires by Hour and Weekday

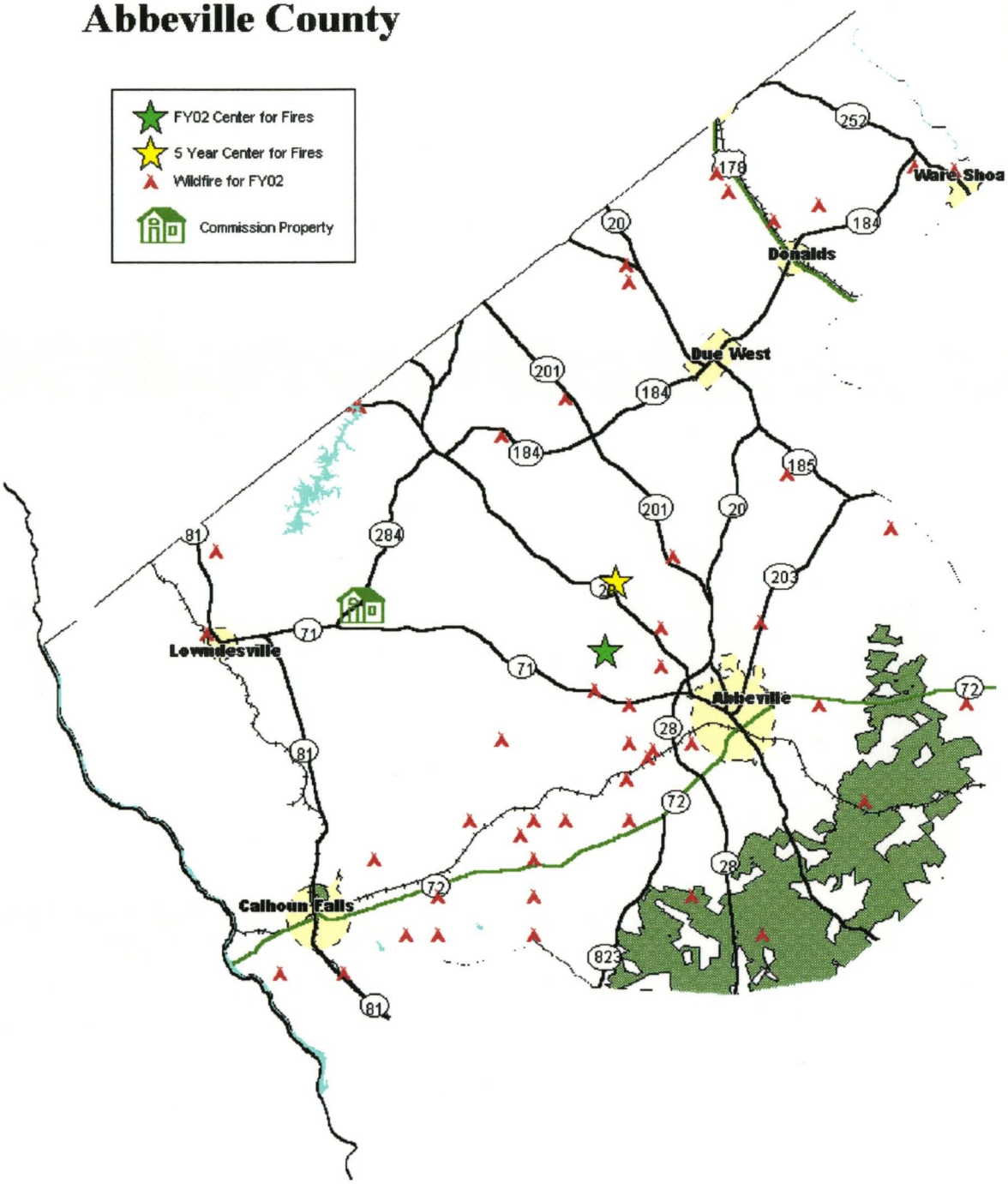


Distribution of Fires by Hour and Month
Fiscal Years 1998 to 2002



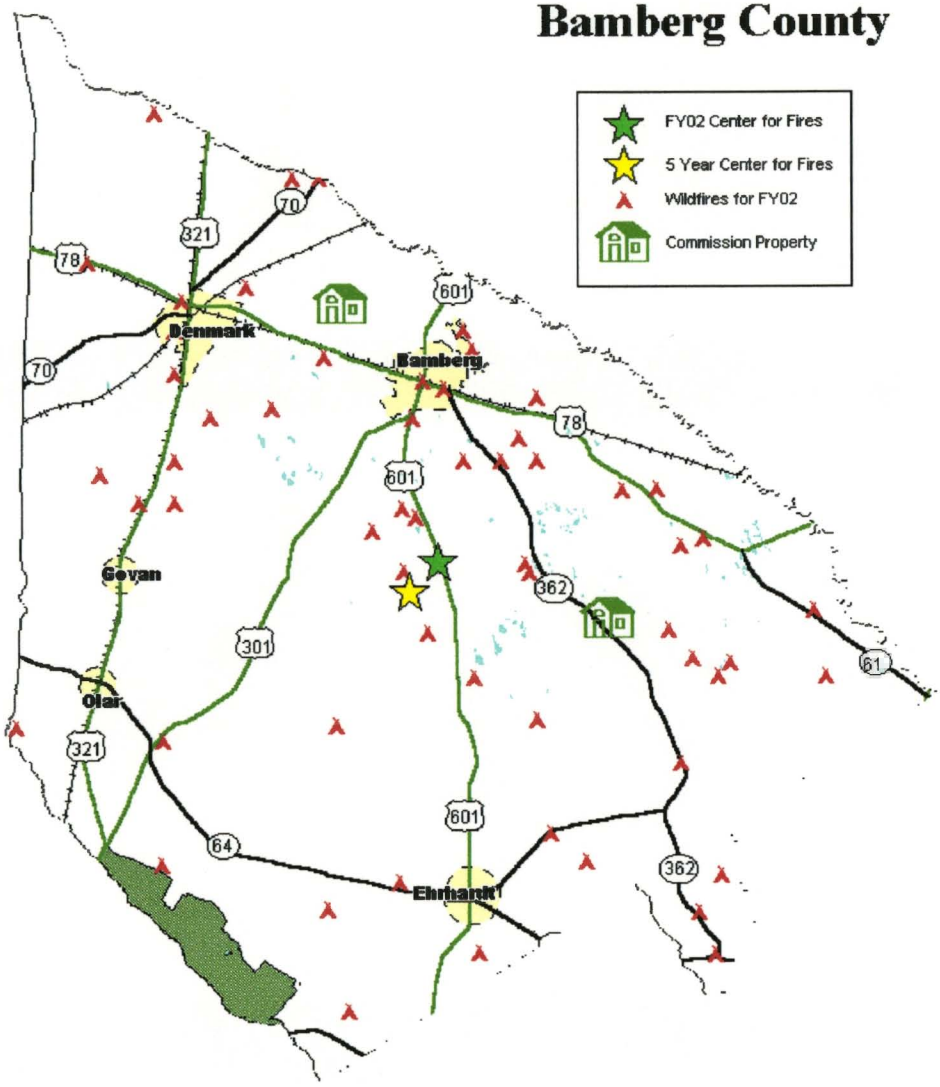


Fires for FY 2002 for Abbeville County

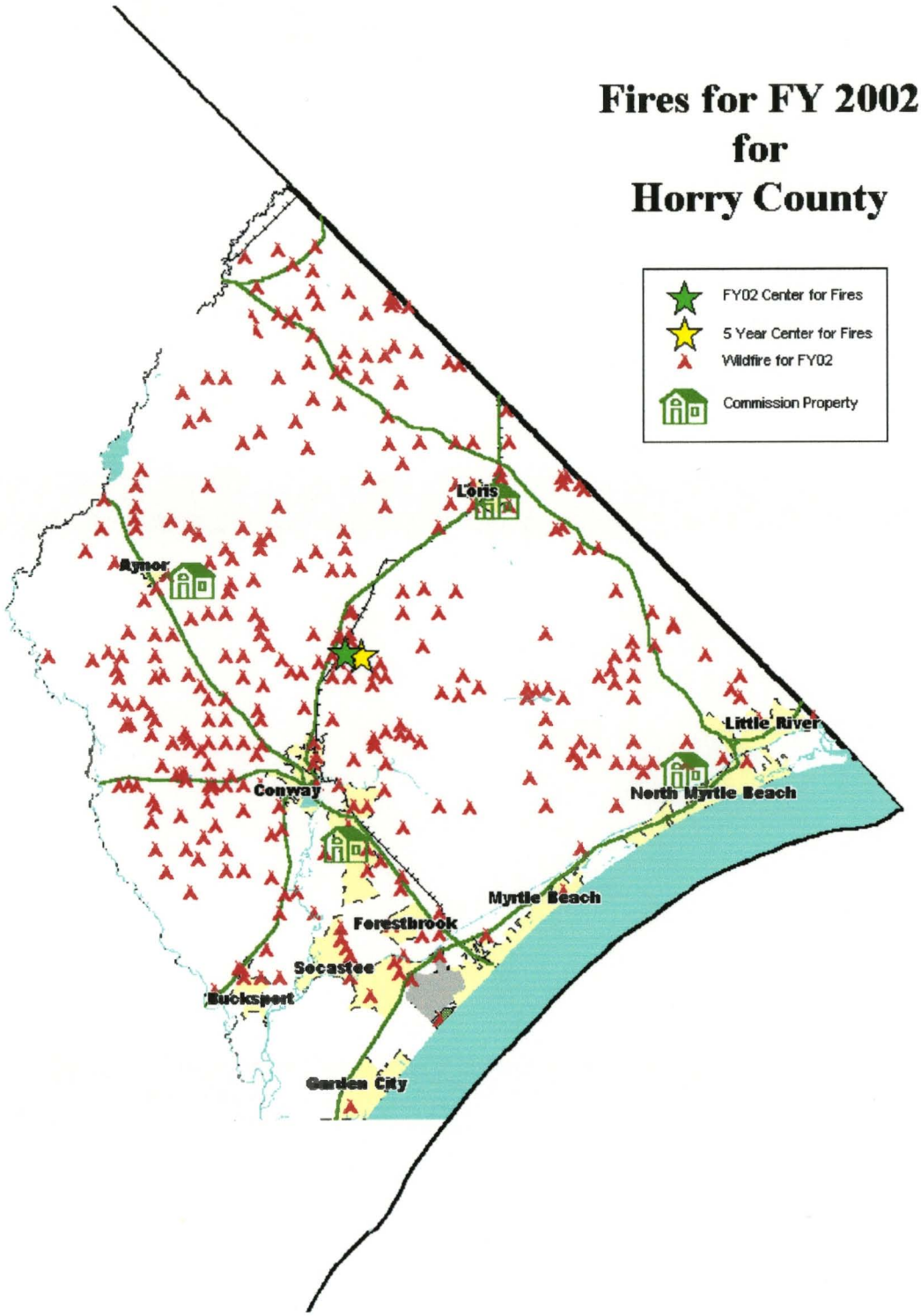


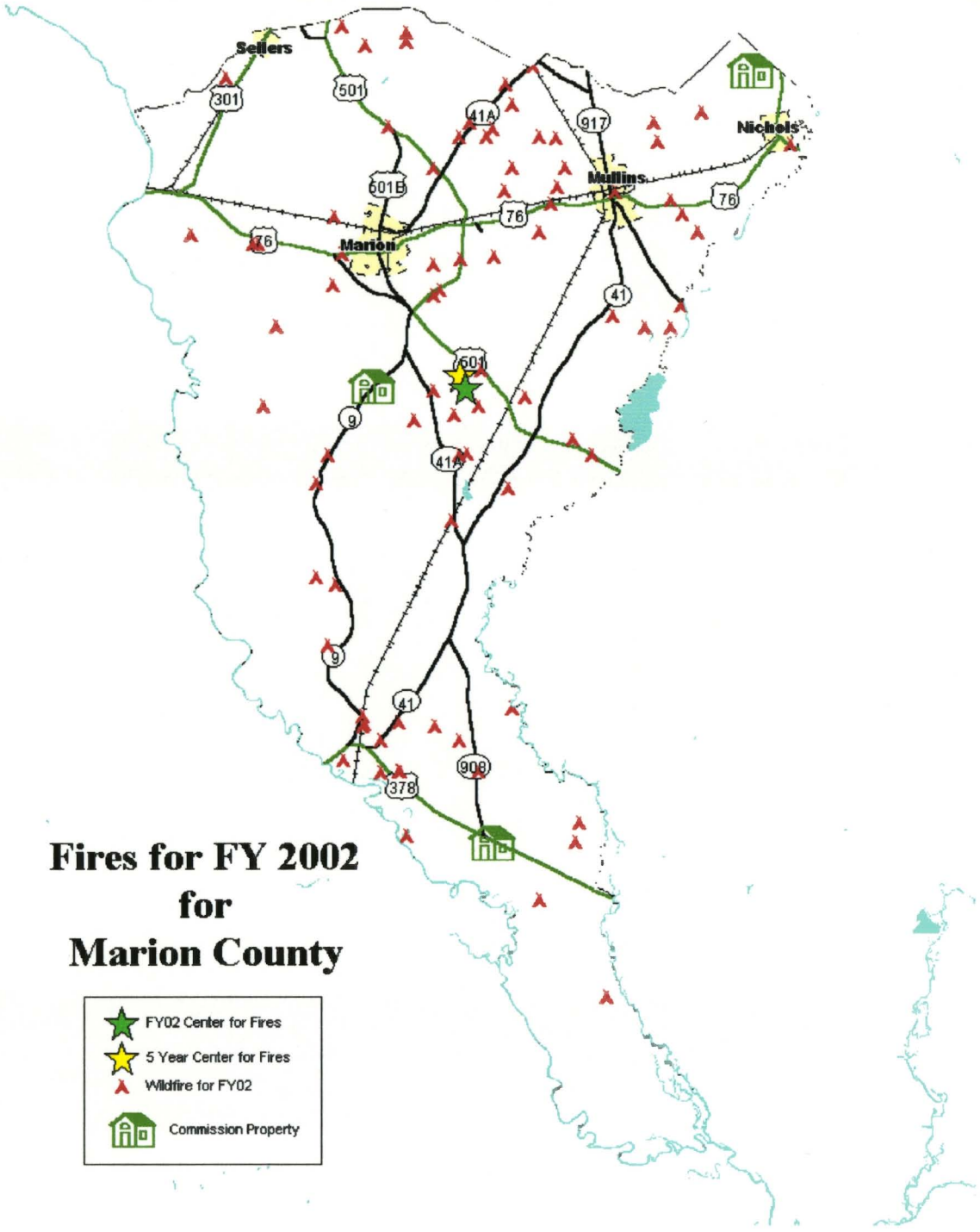
APPENDIX E

Fires for FY 2002 for Bamberg County



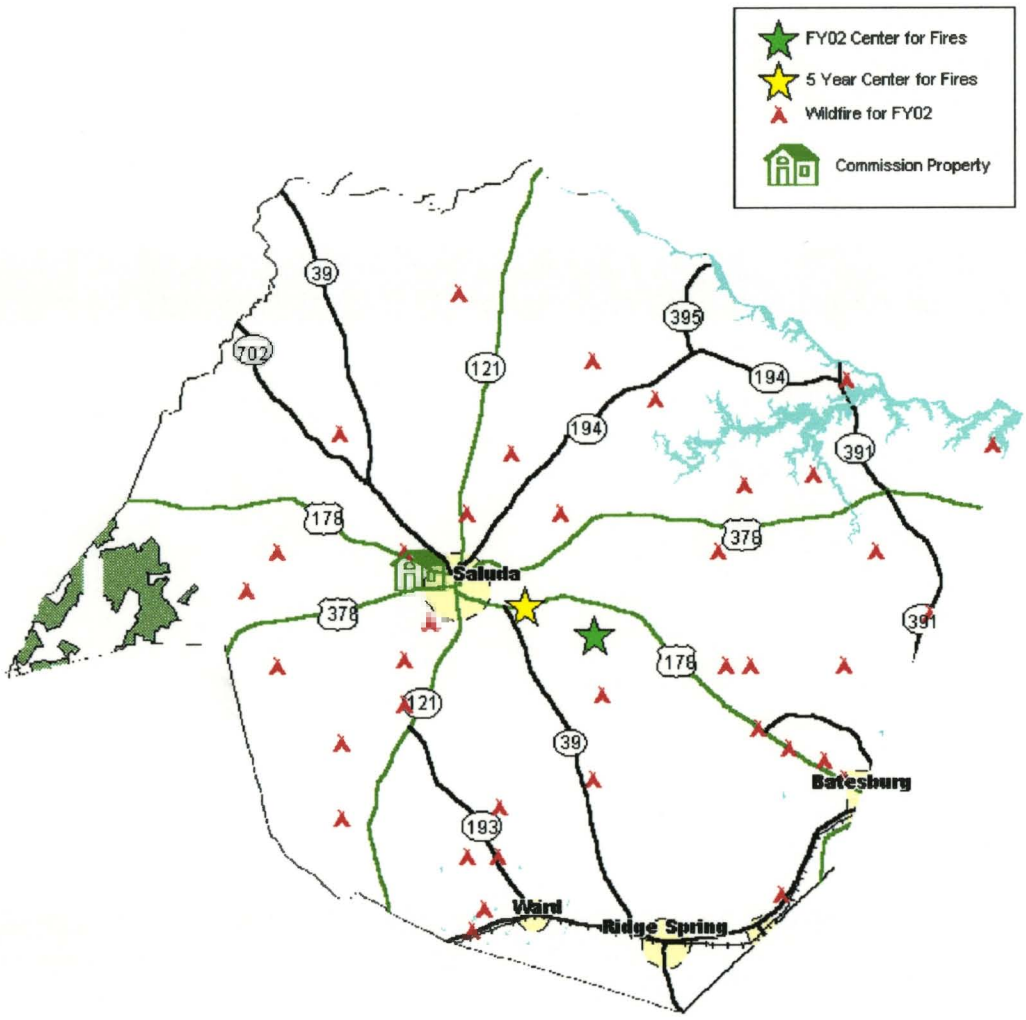
APPENDIX E



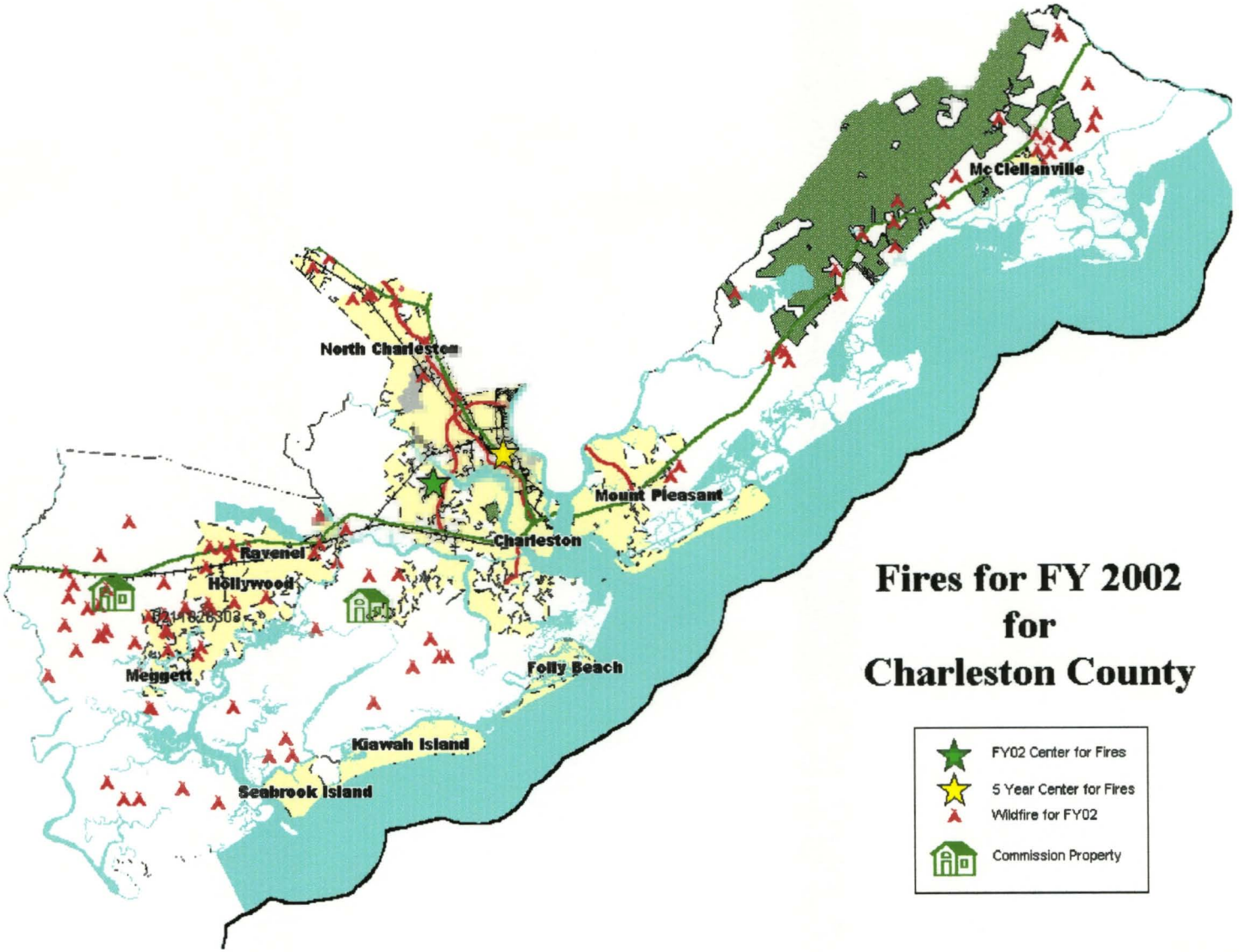


APPENDIX E

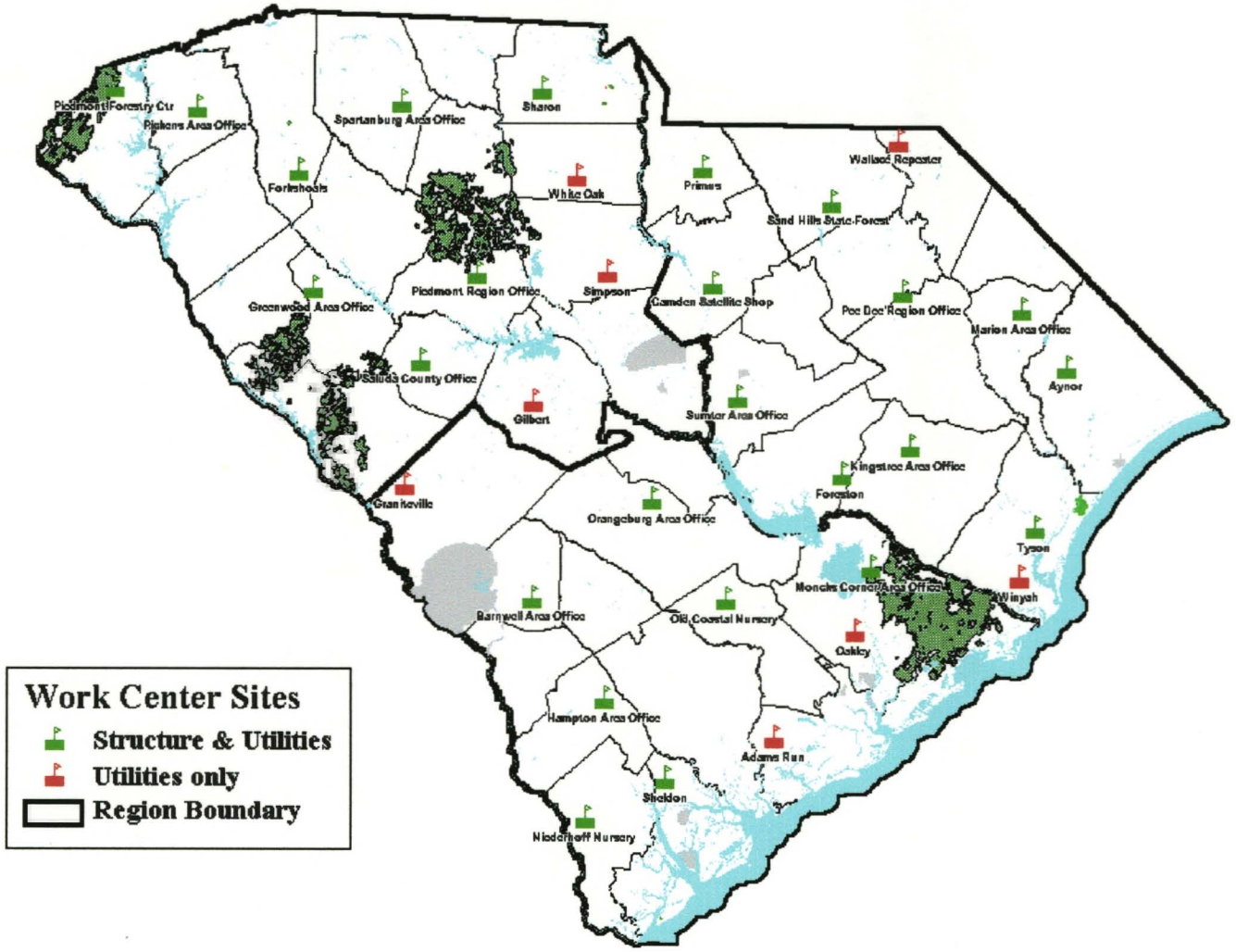
Fires for FY 2002 for Saluda County



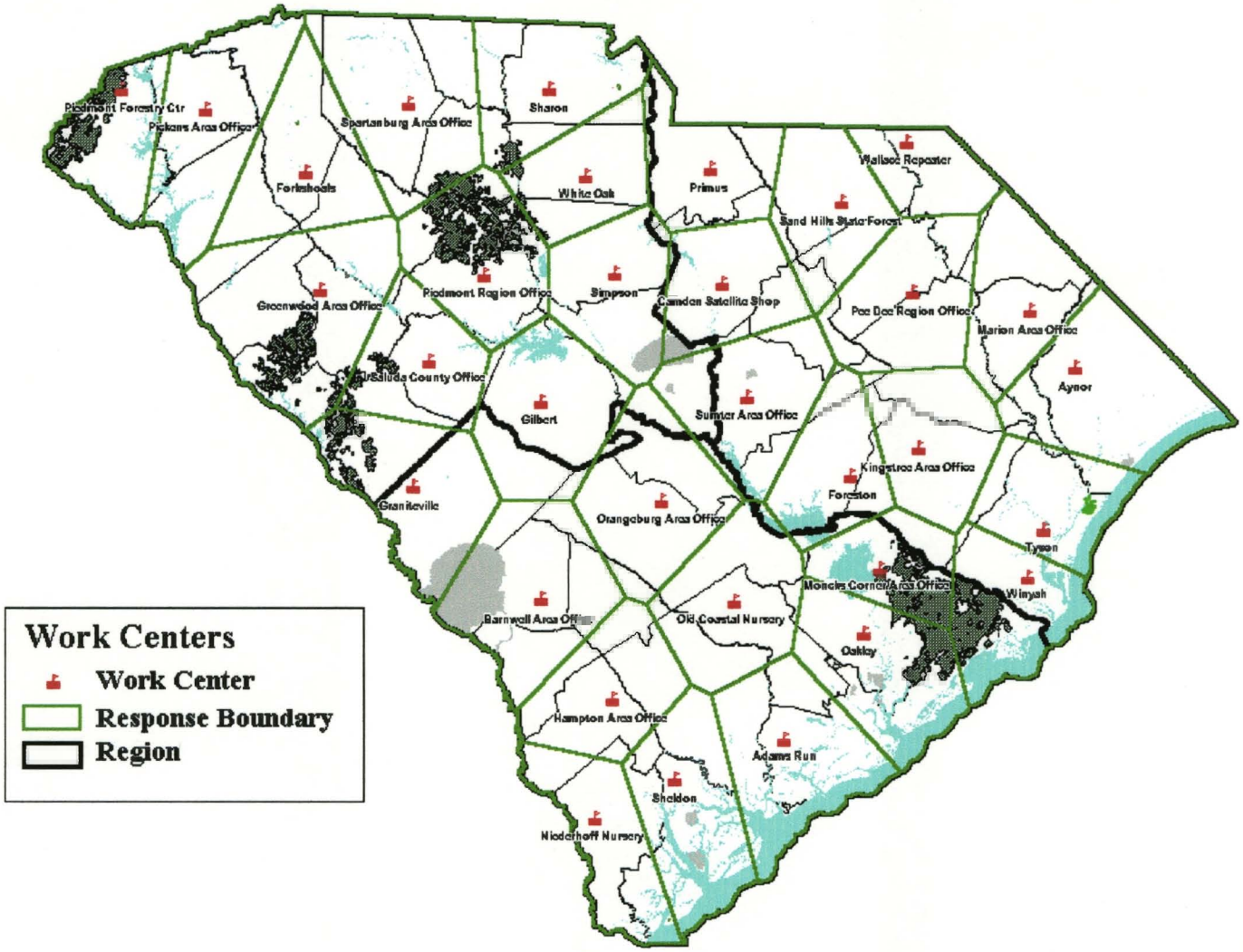
APPENDIX E



CPM Project Analysis -- Work Center Sites



CPM Project Analysis -- Work Center Response Boundaries



APPENDIX G

Comparison of Work Centers Using Fiscal Year 2002 Fire Data

Work Center Location	Work Center Structures	Coverage Area (Sq.Mi.)	Fiscal Year 2002		
			Number of Fires	Acres Burned	Number of Wardens
Adams Run	NO	1,193	145	1,207.9	2
Aynor	YES	1,293	382	5,922.7	6
Barnwell Area Office	YES	1,252	138	599.7	8
Camden Satellite Shop	YES	804	153	920.1	4
Foreston	YES	763	316	3,981.8	4
Forkshoals	YES	1,040	71	297.5	3
Gilbert	NO	1,103	298	811.0	4
Graniteville	NO	1,098	166	541.0	3
Greenwood Area Office	YES	1,557	165	493.3	8
Hampton Area Office	YES	920	199	1,179.3	6
Kingstree Area Office	YES	891	545	6,804.7	8
Marion Area Office	YES	886	206	1,654.1	5
Moncks Corner Area Office	YES	637	253	4,608.8	4
Niederhoff Nursery	YES	827	274	1,749.7	6
Oakley	NO	1,087	278	1,637.5	6
Old Coastal Nursery	YES	1,064	426	2,923.2	7
Orangeburg Area Office	YES	1,112	318	1,202.9	5
Pee Dee Region Office	YES	1,032	376	3,423.1	8
Pickens Area Office	YES	1,173	103	302.9	6
Piedmont Forestry Ctr	YES	678	48	150.9	2
Piedmont Region Office	YES	994	59	154.6	5
Primus	YES	780	100	340.5	3
Saluda County Office	YES	817	60	333.6	4
Sand Hills State Forest	YES	833	157	633.0	3
Sharon	YES	969	78	321.6	3
Sheldon	YES	1,087	189	897.2	5
Simpson	NO	851	111	444.3	5
Spartanburg Area Office	YES	1,325	94	370.8	4
Sumter Area Office	YES	1,043	255	1,518.0	6
Tyson	YES	780	138	973.5	3
Wallace Repeater	NO	519	133	691.7	5
White Oak	NO	726	53	269.6	2
Winyah	NO	882	96	2,029.4	2
State Totals		**32,016**	**6,383**	**49,389.9**	**155**

APPENDIX H

Comparison of Actual Response Time for Initial Attack Warden And Estimated Response Time for Initial Attack Warden Responding from Closest Work Center.

Fire Number	County	Actual Response Time for Initial Attack Warden (Minutes)	Road Miles to Fire from Closest Work Center (Miles)	Estimated Response Time from Closest Work Center (Minutes)	Difference in Response Time (Work Center minus Actual} (Minutes)
11019357	Charleston	124.27	14.15	38.30	-85.97
11020580	Charleston	76.17	23.24	56.48	-19.69
11020978	Charleston	59.30	8.08	26.16	-33.14
11023967	Charleston	62.23	12.80	35.60	-26.63
11024058	Charleston	22.62	7.32	24.64	2.02
11024116	Charleston	59.83	23.38	56.76	-3.07
11025248	Charleston	94.42	4.83	19.66	-74.76
11025588	Charleston	6.30	16.35	42.70	36.40
11026436	Charleston	40.22	9.59	29.18	-11.04
11026445	Charleston	79.35	8.32	26.64	-52.71
11026521	Charleston	7.52	12.59	35.18	27.66
11027228	Charleston	44.60	9.50	29.00	-15.60
11028099	Charleston	66.13	9.50	29.00	-37.13
11028564	Charleston	31.50	20.11	50.22	18.72
Charleston Averages		**55.32**	**12.84**	**35.68**	**-19.64**
12619626	Horry	18.12	7.60	25.20	7.08
226100193	Horry	74.18	4.43	18.86	-55.32
226100446	Horry	60.37	20.63	51.26	-9.11
226100585	Horry	38.03	17.54	45.08	7.05
226100709	Horry	2.98	2.92	15.84	12.86
226101024	Horry	35.68	18.44	46.88	11.20
226101281	Horry	27.70	18.61	47.22	19.52
226101803	Horry	23.10	14.15	38.30	15.20
226101839	Horry	72.53	5.64	21.28	-51.25
226102386	Horry	94.72	16.42	42.84	-51.88
226102421	Horry	35.98	3.29	16.58	-19.40
226102458	Horry	12.13	19.64	49.28	37.15
226102524	Horry	33.02	9.48	28.96	-4.06
226102616	Horry	29.27	7.04	24.08	-5.19
226102703	Horry	73.90	18.88	47.76	-26.14
226102772	Horry	37.18	9.26	28.52	-8.66
226102836	Horry	110.23	11.21	32.42	-77.81
226103104	Horry	46.23	2.35	14.70	-31.53
226103127	Horry	16.03	11.90	33.80	17.77
226103315	Horry	22.80	9.94	29.88	7.08
226103508	Horry	56.50	7.36	24.72	-31.78
226103640	Horry	97.47	27.10	64.20	-33.27
226103687	Horry	50.85	11.20	32.40	-18.45
226103770	Horry	83.42	19.03	48.06	-35.36
226104035	Horry	53.47	5.98	21.96	-31.51

APPENDIX H

Fire Number	County	Actual Response Time for Initial Attack Warden (Minutes)	Road Miles to Fire from Closest Work Center (Miles)	Estimated Response Time from Closest Work Center (Minutes)	Difference in Response Time (Work Center minus Actual} (Minutes)
226104079	Horry	51.03	9.94	29.88	-21.15
226104104	Horry	11.48	12.77	35.54	24.06
226104233	Horry	46.22	6.51	23.02	-23.20
226104292	Horry	29.77	19.96	49.92	20.15
226104325	Horry	47.02	11.55	33.10	-13.92
226104337	Horry	43.83	12.72	35.44	-8.39
226104356	Horry	35.17	23.42	56.84	21.67
226104426	Horry	86.35	22.79	55.58	-30.77
22627663	Horry	41.32	13.37	36.74	-4.58
22628071	Horry	80.23	5.29	20.58	-59.65
22628683	Horry	70.55	10.28	30.56	-39.99
22629153	Horry	33.72	10.56	31.12	-2.60
22629617	Horry	32.30	20.26	50.52	18.22
22629689	Horry	46.18	26.33	62.66	16.48
22630250	Horry	47.22	14.17	38.34	-8.88
22630267	Horry	16.23	13.80	37.60	21.37
22630275	Horry	39.75	8.13	26.26	-13.49
22630332	Horry	32.12	14.31	38.62	6.50
22630430	Horry	97.05	12.09	34.18	-62.87
22630653	Horry	53.67	5.59	21.18	-32.49
22630888	Horry	41.83	8.32	26.64	-15.19
22631227	Horry	33.73	18.33	46.66	12.93
22631568	Horry	40.32	18.54	47.08	6.76
22631888	Horry	70.77	3.87	17.74	-53.03
22631932	Horry	19.28	12.62	35.24	15.96
22631996	Horry	46.38	6.44	22.88	-23.50
22632355	Horry	17.20	16.09	42.18	24.98
22632364	Horry	25.87	5.68	21.36	-4.51
22632429	Horry	13.25	11.96	33.92	20.67
22633012	Horry	29.17	5.93	21.86	-7.31
22633120	Horry	29.20	26.63	63.26	34.06
22633425	Horry	76.82	10.08	30.16	-46.66
22633652	Horry	62.03	20.87	51.74	-10.29
22634375	Horry	27.50	17.53	45.06	17.56
22634905	Horry	35.63	14.88	39.76	4.13
22634982	Horry	39.32	13.23	36.46	-2.86
22635508	Horry	21.63	21.62	53.24	31.61
22635562	Horry	40.33	10.24	30.48	-9.85
Horry Averages		**44.72**	**12.96**	**35.93**	**-8.79**

APPENDIX H

Fire Number	County	Actual Response Time for Initial Attack Warden (Minutes)	Road Miles to Fire from Closest Work Center (Miles)	Estimated Response Time from Closest Work Center (Minutes)	Difference in Response Time (Work Center minus Actual} (Minutes)
234101866	Marion	29.48	10.29	30.58	1.10
234103808	Marion	8.68	16.47	42.94	34.26
234104199	Marion	35.78	3.05	16.10	-19.68
23428659	Marion	30.62	5.29	20.58	-10.04
23430196	Marion	48.90	19.31	48.62	-0.28
23430469	Marion	19.02	19.51	49.02	30.00
23433311	Marion	51.78	36.34	82.68	30.90
23433578	Marion	38.20	7.04	24.08	-14.12
23433599	Marion	75.60	4.89	19.78	-55.82
23433742	Marion	55.63	9.26	28.52	-27.11
23434970	Marion	24.97	15.47	40.94	15.97
23435822	Marion	5.63	9.84	29.68	24.05
23435926	Marion	94.42	19.86	49.72	-44.70
Marion Averages		**39.90**	**13.59**	**37.17**	**-2.73**
34157541	Saluda	22.30	11.48	32.96	10.66
34157726	Saluda	26.02	13.94	37.88	11.86
34158666	Saluda	15.62	5.55	21.10	5.48
34159695	Saluda	10.20	12.64	35.28	25.08
34160693	Saluda	23.65	13.66	37.32	13.67
34161033	Saluda	5.00	8.86	27.72	22.72
34161202	Saluda	5.45	10.44	30.88	25.43
34161223	Saluda	18.10	2.48	14.96	-3.14
34161504	Saluda	15.02	17.61	45.22	30.20
34162587	Saluda	20.63	6.30	22.60	1.97
Saluda Averages		**16.20**	**10.30**	**30.59**	**14.39**
3158945	Abbeville	18.53	28.74	67.48	48.95
3159429	Abbeville	14.30	31.84	73.68	59.38
3161416	Abbeville	17.25	18.80	47.60	30.35
3158997	Abbeville	13.83	22.39	54.78	40.95
3161450	Abbeville	18.02	24.92	59.84	41.82
3161477	Abbeville	10.42	17.18	44.36	33.94
3161427	Abbeville	5.53	13.12	36.24	30.71
3162079	Abbeville	25.32	30.08	70.16	44.84
3159078	Abbeville	3.23	17.72	45.44	42.21
3158885	Abbeville	32.05	26.98	63.96	31.91
Abbeville Averages		**15.85**	**23.18**	**56.35**	**40.51**

APPENDIX H

Fire Number	County	Actual Response Time for Initial Attack Warden (Minutes)	Road Miles to Fire from Closest Work Center (Miles)	Estimated Response Time from Closest Work Center (Minutes)	Difference in Response Time (Work Center minus Actual} (Minutes)
1525178	Bamberg	36.63	19.88	49.76	13.13
1521008	Bamberg	35.03	19.57	49.14	14.11
1518241	Bamberg	26.75	24.53	59.06	32.31
1521208	Bamberg	29.78	22.74	55.48	25.70
1528522	Bamberg	56.20	15.80	41.60	-14.60
1525591	Bamberg	36.92	16.88	43.76	6.84
1525564	Bamberg	32.37	23.43	56.86	24.49
1524849	Bamberg	64.95	22.44	54.88	-10.07
1523703	Bamberg	22.98	19.89	49.78	26.80
1526221	Bamberg	28.18	23.57	57.14	28.96
Bamberg Averages		**36.98**	**20.87**	**51.75**	**14.77**
		Actual Response Time for Initial Attack Warden (Minutes)	**Road Miles to Fire from Closest Work Center (Miles)**	**Estimated Response Time from Closest Work Center (Minutes)**	**Difference in Response Time (Work Center minus Actual} (Minutes)**
Project Area Averages		**40.01**	**14.30**	**38.61**	**-1.40**